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CENTRAL INTELLIGENCE AGENCY

INFORMATION REPORT

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SECURITY INFORMATION

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COUNTRY USSR (Kalinin Oblast)

REPORT

SUBJECT Water Canal Development at Branch No. 1, Institute 88, Gorodomlya Island

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REFERENCES

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THE SOURCE EVALUATIONS IN THIS REPORT ARE DEFINITIVE.
THE APPRAISAL OF CONTENT IS TENTATIVE.
(FOR KEY SEE REVERSE)

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1. The water canal at Ostashkov / [] refers to the installation on Gorodomlya Island [] 7 was usable only for investigations of two-dimensional gas flows. Its advantage was its simplicity which resulted in low-cost experiments. Furthermore, the production of models for the water canal was simpler than for the wind tunnel. It is possible to observe an experiment in a water canal for an unlimited period of time, whereas such time is very limited in the wind tunnel, and experimentation is not possible during the operation of the wind tunnel. [] 50X1-HUM
[] it will never be possible to completely substitute the water canal for the wind tunnel, although it is possible to greatly reduce the number of the very expensive wind tunnel experiments by carrying out preliminary experiments in a water canal. 50X1-HUM
2. The main difficulty in the use of the water canal at Ostashkov was the wave which formed at the bow, for which there was no analogy in a gas problem. Its influence was to be countered by the use of low water levels and large models.

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[redacted] inadvisable to go too far in this respect because the influence of the boundary layer which develops at the bottom then becomes noticeable.

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3. A further difficulty can occur if processes are used which develop adiabatically rather than isothermally. As is known, the analogy does not then accurately apply. Compression shocks are examples of non-isothermal phenomena.
4. However, these factors cannot considerably reduce the usefulness of the water canal, especially if sufficient consideration is given to them during, or in the evaluation of, the experiments.
5. The essential theory for this work appears in an article written by E. PREISWERK, entitled "Applications of the Methods of Gas Dynamics to Water Flows with Free Surfaces".
6. All of the equipment except the basin was built at Ostashkov; the basin was built in Moscow (at NII-88 (?)) after the Germans had departed. Dr. SCHMIEDEL had built the small basin [see Figure 2 page 6] and had designed the large basin [see Figure 1, page 5] before he died. [redacted]

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7. The Soviets showed very little interest in this work, and were contemptuous of it, making no effort to hide their objections as to its practicability. They changed their attitude [redacted] however, and agreed that the method had real value. But they still seemed uninterested in the details.

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8. [redacted]

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9. Five problems [redacted]

- a. Investigation of the analogy between water flow and gas flow (gas with $K=2$) on models.

This investigation compared the water levels with the pressure or densities calculated for gas with $K=2.0$. Theoretically, an analogy exists between the density of the gas and the depth of the water.

The following models were examined with various angles of incidence (α):

- (1) Plates (100, 200, 300 millimeters in length)
- (2) Wedges [see Figure 4, page 6]
- (3) Models with oval contour [see Figure 5, page 6]

The following were measured:

- (1) The water level on the model by reading the level with a gauge which is fastened to the model.
- (2) The water level on the model by use of a height meter [see Figure 7, page 7]
- (3) The tangential and normal force by use of the balance [see Figure 3, page 6]

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The coefficients were thus calculated.

In general, the analogy was confirmed by the experiments. Deviations were observed because of the wave which formed at the bow of the model. There is no analogy for it in the flow of gas. In order to keep the influence of this deviation small, the models must not be too small (200-300 millimeters) and the water level not too great.

- b. Investigation of the analogy as it applies to jets. Measurements were made on a model [see Figure 6, page 7] which had been constructed for $M = 2$ (M is used here as Mach number). The water level was measured along the middle axis and on the sides of the model. The values obtained correspond to those which are anticipated according to the analogy.
- c. Investigation of the stern resistance as it applies to various models.

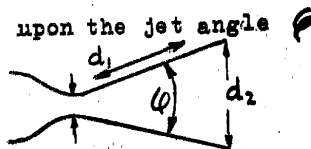
The stern resistance for various models as it depends on the Mach number was examined and the results were compared with the values known from literature. Specifically, the influence of the length of the model on stern drag was examined.

The water level was measured at the stern of the model, and from it the coefficient of resistance was determined. Pictures were taken of the water flow.

In agreement with the values available in literature, the coefficient of resistance is at its maximum if $M = 1$. As the Mach number increases it becomes smaller, and beginning with $M = 2.5$ it corresponds to the value which would exist if $h = 0$ (for gas, this corresponds to $P = 0$).

- d. Investigation of the discharge from jets with straight walls.

The thrust produced by a jet depends upon the jet angle ϕ and the ratio of diameters d_2 / d_1 .



This influence was to be examined through experiments in the water canal with various outside pressures. Outside pressure (Aussdruck-Gegendruck) is pressure (water height) measured several centimeters ahead of the model.

The models with $\phi = 20$ to 90° and with various lengths were examined. The water level was determined along the axis, along the wall, across the narrowest point, and across the exhaust aperture. From these measurements the thrust was determined. Pictures were also made of the current. Various outside pressures were produced by raising the baffle plate [see Figure 1, page 5].

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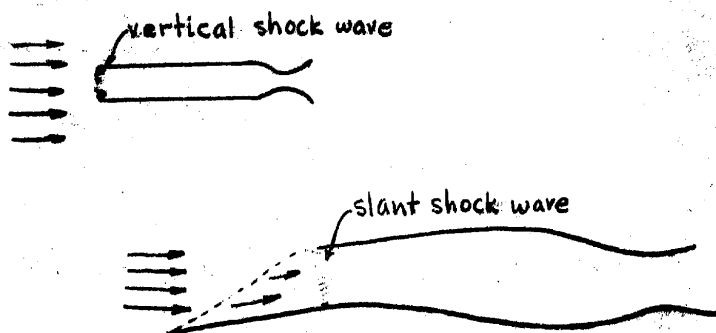
The progress of current inside and outside of the jet was determined by means of the flow pictures. In some cases a separation of the current from the jet wall was observed. This separation occurs when the water level at the wall has dropped to the value of the water level outside of the jet (outside pressure). The conditions for maximal thrust could be determined.

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e. Investigation of the use of diffusers for supersonic currents.

The assignment was to determine the degree of efficiency of diffusers for supersonic current for which the compression is accomplished either through a vertical shock or through one or several inclined shocks plus one vertical shock (Oswatitsch-Diffusor) (sic).

The following type models were built:



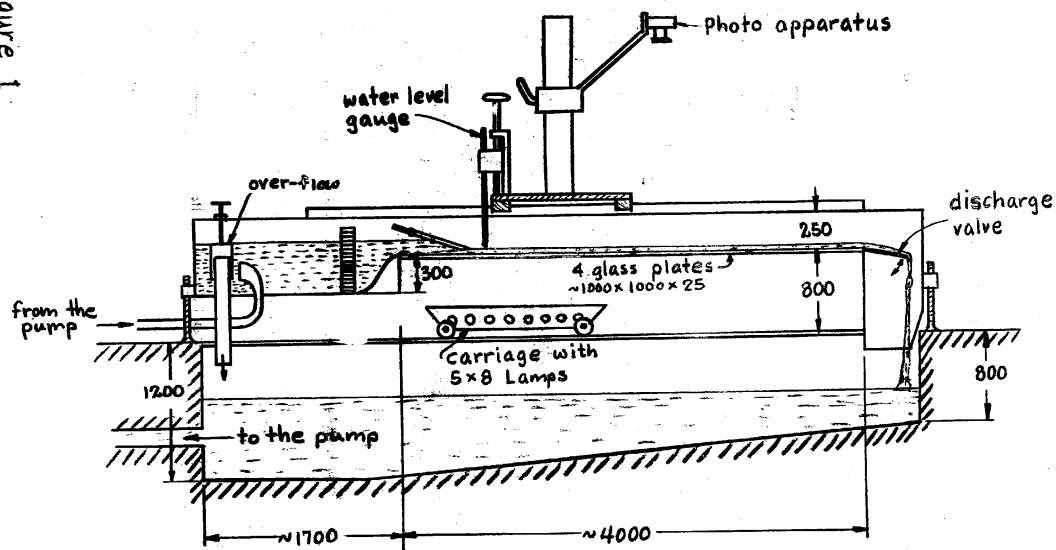
Dynamic pressures before and after conversion were measured
/see Figure 8, page 7 /.

The experiments showed a great improvement in the degree of efficiency if "Oswatitsch" (sic) diffusers are used. The values measured corresponded quite closely to those claimed by theory.

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Figure 1
LARGE WATER CHANNEL (All dims in millimeters)



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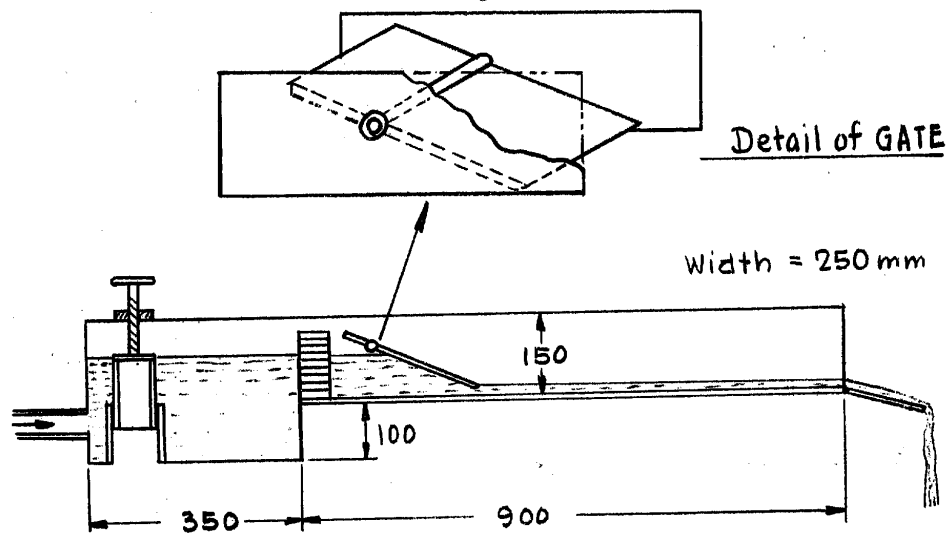


Figure 2. SMALL WATER CHANNEL

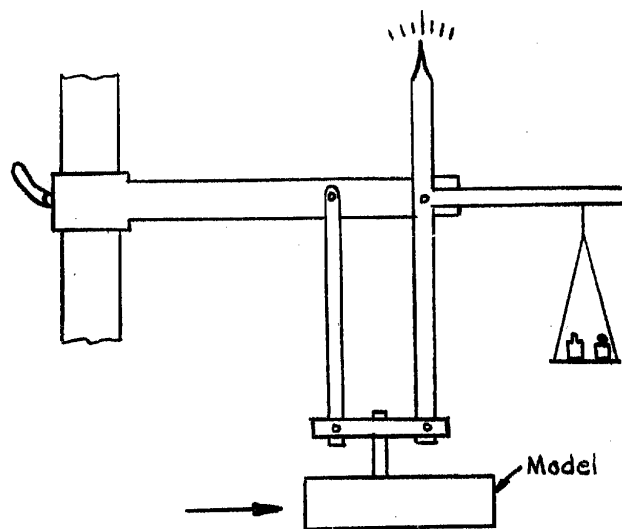


Figure 3. SCALE

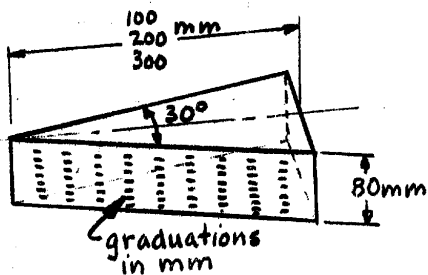


Figure 4. WEDGE MODEL

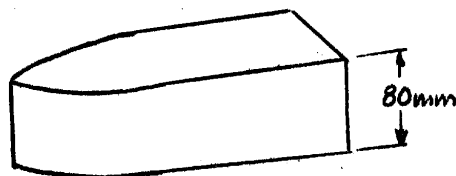


Figure 5. OVAL MODEL

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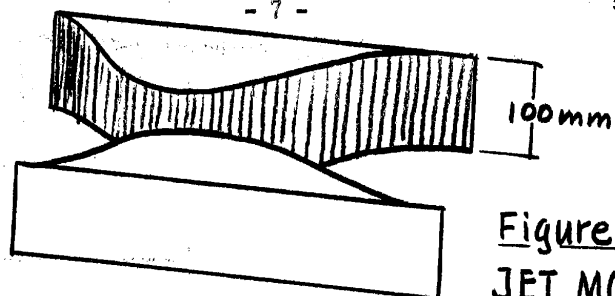


Figure 6.
JET MODEL

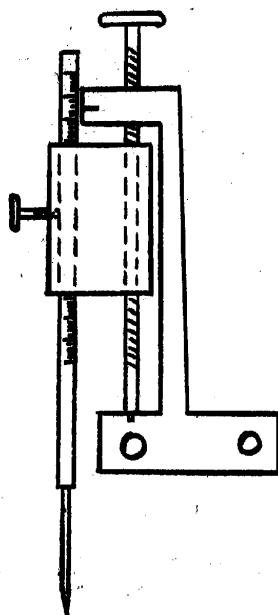


Figure 7.
APPARATUS for Measuring
the Water Level

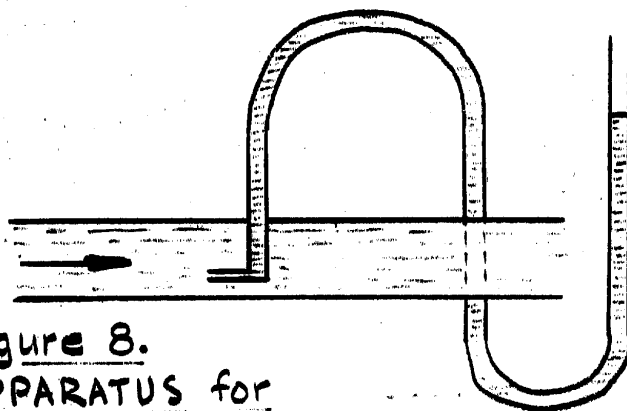


Figure 8.
APPARATUS for
Measuring Dynamic Pressure

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